Performance, vision and sport – a practitioner's guide

Part 1 - Getting started

In the first of a new CET-approved series, sports vision specialist **Geraint Griffiths** introduces practitioners to the concept of performance vision in sport and explains how it can be incorporated into everyday practice. **Module C8787, one general CET point, suitable for OOs and DOs**

Sport matters in people's lives today. Growing concern about obesity and fitness levels means that sport is increasingly seen as essential to our health and well-being rather than a lifestyle choice. Yet how many eye care professionals regularly factor sport in to their patient offering? Arguably not nearly enough.

Current levels of participation in sport suggest there is a major opportunity for practitioners to get involved. Among the UK population – now around 60 million with 48 million aged 16 or over – more than half of all adults (59 per cent) say they have taken part in a sport, game or physical activity in the past four weeks and three quarters (75 per cent) say they have participated during the past year.[1]

Taking the top six most popular outdoor sports alone, nearly 17 million (or 35 per cent of all adults) list walking as a regular recreation. Like many sports, this covers a range of activities from gentle rambling to strenuous mountain walks and power walking. More than four million regularly ride bicycles – whether mountain bikers, road racers or cycling tourists.

Around two million adults in the UK list running as a pastime – jogging, on the athletics track or on roads or trails – and similar numbers play golf on a regular basis or are footballers. Almost one million Britons now play tennis. Of the indoor sports, swimming is by far the most popular with nearly seven million frequent participants.

Sport is a passion with people of all ages and both genders. Beyond the sporting 'big six' described above, there are countless other major and minor sports, from cricket to croquet, each with its devotees.

Millions of these enthusiasts are among the 17.5 million in the UK who seek an eye examination every year.[2] Yet how many realise that sports eye care and eyewear exist, or that informed advice – plus appropriate vision correction – could add to their comfort, their sporting performance, or even their eye health and safety? Athletes and eye care professionals alike could benefit from a better understanding of visual aspects of sport – a fascinating subject that has the potential to generate real excitement in your practice.

Why get involved?

It is clear that there is a visual component to sport but, surprisingly, a general lack of awareness that this actually contributes to performance. Although athletes, in general, recognise that vision is important, many mistakenly believe their eyes are perfect. Even in elite groups, up to 40 per cent have visual problems that are amenable to correction and improvement.[3] A study in the US found that 25 per cent of athletes competing at a high level had never had a complete eye examination, although 29 per cent had visual symptoms and 28 per cent had less than 20/25 (ie 6/7.5) acuity with their habitual sports prescription and protective eyewear was not often used.[4]

This suggests that eye care professionals are not reaching out to athletes in the way they should to explain the relationship between vision and sport- ▶

ing performance. One reason may be that practitioners themselves fail to appreciate the importance of visual performance in sport. They may believe that sports vision assessment and training is only for elite athletes, rather than those who participate in recreational sports, or that they need to be sporting experts to get involved. Alternatively, they may consider it to be too costly or complex for everyday practice.

To some, the fact that sports vision has its roots in behavioural optometry may be a barrier. Behavioural optometry assumes a feedback loop from behavioural or occupational therapy to visual performance, and has been applied to groups such as children with learning difficulties. However, practitioners may question the wider application of behavioural optometry to sport and whether this approach is appropriate for athletes who present without a specific sporting problem.

One school of thought is that all those who participate in sport will benefit from proactive visual therapy, but without a formal understanding based on measurable and tested data this is difficult to substantiate. Even if athletes benefit from a therapy, some will benefit more than others, some will be more compliant and some will refuse all assistance, and practitioners will not be confident entering a new field of expertise without knowing why.

Yet despite these reservations, there are many good reasons for getting involved in sports vision. Extending your scope of practice into new areas can be rewarding from a personal point of view as well as introducing new revenue streams to your business. In an increasingly challenging business environment, it is also important to distinguish your practice from those of your competitors by offering specialist products and services. Involvement with sport can create opportunities for marketing your practice, locally or even nationally. And for the many practitioners who have a personal interest or experience in sport it can also be great fun.

The vision performance specialist can be defined as someone who helps the athlete reach his or her maximum potential through various visual means, utilising both products; contact lenses, spectacles, specialist and protective eyewear and services; visual skills evaluation and, in some cases, training or enhancement. Vision performance specialists are most likely to be eye care professionals but athletic trainers may also be involved.

It is important to remember that sport can have adverse effects on the eye, since it is one of the major causes of serious eye injuries. Ophthalmologists are therefore another profession with a potential interest in this area. Of those eye injuries that reach a hospital accident and emergency department only a small proportion (2.3 per cent) are sustained during sport.[5] However, while an injured patient has about a 2 per cent chance of requiring admission to hospital, for eye injuries sustained during sport this rises to 27 per cent.[6] A recent study in Scotland found that in 12.5 per cent of patients admitted to hospital for ocular trauma, the injury resulted from playing a sport. Racquet sports together accounted for nearly half of these injuries (47 per cent) and the single most common sport involved was football (32 per cent).[7]

To become a vision performance specialist it is advisable to have some interest in sport but it is a myth that practitioners need to be sporting experts. Sport is the commonest and most diverse pastime you are likely to encounter among your patients and not even the most avid sporting practitioner could have personal experience of every event. Nor should you assume that professional athletes and Olympic hopefuls are likely to be the only candidates for specialist assessment and training. Many patients in your practice are recreational athletes and other groups with high visual demands, such as police, pilots and the armed forces, may also benefit.

At its most basic level, specialising in vision performance and sport may simply mean ensuring that your examination, prescribing and dispensing pay close attention to the visual requirements of these patients and reflect the tasks involved in their chosen sport. For some, this may just be a question of upgrading the products and services that you already offer and taking a greater interest in the contribution of vision to various sports. You may, for instance, want to start simply by correcting small amounts of spherical and cylindrical refractive errors, recommending the most appropriate form of vision correction, and advising on UV and eye protection.

More than four million people in the UK regularly ride bicycles

You may prefer to invest in additional equipment for skills assessment, or offer protective and specialist sports eyewear. Examples here would be conducting a detailed 'visual task analysis', adding new tests to your routine appropriate to individual sports, and supplying eye protection for activities such as swimming and racket sports. Alternatively, you may want to become fully involved in sports vision, introduce new equipment for measuring specific sporting skills such as anticipation and hand/eye coordination, provide vision training as well as assessment, and offer your services to elite sports groups. The choice is yours.

The aim of this series of CET-approved articles is to provide a starting point for interested practitioners to learn more about sport and vision. The first two parts are designed to introduce practitioners to the concept of performance vision in sports, and to show why and how it can be incorporated in everyday practice. The series will then look in detail at the visual skills involved in a variety of popular sports. It will review the different methods of correction and protection, and how to tailor these to individual sports. The final parts of the series will examine specialist sports vision testing equipment and the types of vision training available for enhancing performance, including computer-based techniques.

What is the connection between vision and sport?

It may seem obvious that vision and sporting performance are linked in some way, but the lack of supporting evidence for this association has prevented wholehearted professional commitment, even with increasing demand from the general sporting public. Scientific proof of a direct relationship could have a profound effect on optometric thinking, since this might also have implications in other areas of occupational optometry, such as vision and driving, where an association is also difficult to establish.

Over the past 10 years or so, evidence has begun to emerge which clarifies the debate. Several studies have compared visual performance among elite athletes with that of the general population and found significant differ-

ences. Researchers in the US measured the visual acuity, stereo acuity and contrast sensitivity of professional baseball players and found that they had significantly better visual skills.[8] These athletes had an average visual acuity of 20/12.5 (ie better than 6/4). On all tests of contrast sensitivity, and at all spatial frequencies, the baseball players had a greater sensitivity than the general population. Distance stereo acuity was also superior.

The Sports Vision Association (SVA) and The Sportvision Group (TSVG) have screened more than 400 athletes from 23 elite local, national and international teams, ranging from the Yorkshire cricket team to the British Olympic yachting squad. Table 1 shows the wide range of groups that have been screened over a period of 10 years. Table 2 presents some examples of how individual athletes can be helped by appropriate evaluation and intervention.

One of the many interesting patterns to emerge is in eye dominance, an aspect of vision that, although relatively well covered in the literature in relation to sport, remains controversial. There are many different tests for eye dominance but poor agreement between tests as to the dominant eye. In fact it has even been suggested that, under normal binocular conditions, eye dominance may not exist. The concept of 'ocular preference' has been proposed to describe the choice of one eye over the other only when sufficient stress is placed on the binocular system.[9] The influence of eye dominance and handedness on sporting performance is also controversial. Some US studies of baseball players, for instance, have found a relationship between eye and hand dominance and athletic proficiency while others have not.[10,11]

Practitioners can take the opportunity to offer specialist sports eyewear

Data from sport vision screenings have confirmed previous findings that eye dominance is not an infallible predictor of hand dominance. Eye dominance in elite athletes might have been expected to follow a similar pattern to the general population, that is predominantly right eyed and right handed, but this was not the case. In archery, up to 80 per cent of athletes screened were right-handed and right-eye dominant (right ipsilateral or matched dominance). However, in cricket, fewer than half the players screened were right dominant, the others showing crossed dominance (right or left contralateral).[12] Among yachtsmen, a majority were left-eye dominant.[13] These findings suggest that eye dominance is an important aspect of vision in sport and may predispose people to particular sports. There is now evidence that eye dominance and dominance type may be key to the understanding of performance vision.[14]

The visual skills of elite athletes may thus be different from those of the general population and may differ between sports. However, whether vision training or enhancement can improve athletic performance is subject to further debate. Some authors have reported significant improvements in performance following visual training in baseball, volleyball and hockey, and others have found that the perceptual skills of elite athletes can be trained, especially in younger players. The case for vision training will be examined in more detail in the final parts of this series.

It is certainly true to say that, in many respects, assessing the elite athlete requires a different approach to that applied to the recreational athlete and to the general population. Let us start by looking at some of the terminology used by vision performance specialists and the aspects of vision they are likely to test.

TABLE 1
Sports vision screening of elite groups

- British national archery squad
- British women's hockey team
- National and junior small bore rifle teams
- British Olympic yachting squad
- Yorkshire cricket team
- The Scottish Cricket Union
- Lillehammer 1994 Olympic Winter Games
- Ipswich Town youth team
- Subaru rally cross
- English National Squash Championships
- The Lilleshall School Of Soccer Excellence
- Leyton Orient Football Club squad
- Nottingham Forest U14 squad
- Manchester City FC Football Academy, U13 players
- All England Netball Association panel umpires
- English Golf Union
- English Ladies Golf Association
- Marsh Classic Masters Tennis
- Braintree clay-pigeon shooting club
- Loughborough University cricket squad
- Formula 1 BAR Honda

TABLE 2
Examples of sports vision evaluation and intervention

Pistol shooting – Male, age 58
Small degree of uncorrected distance hyperopia and presbyopia was causing blur of the foresight of the pistol (in shooting, the priority is a clear foresight at the end of the barrel of the gun, not a clear target). Distance vision was fully corrected with an additional +0.75D near addition to bring the foresight into clear focus, glazed into shooting spectacles
Cricket – Male, age 16
A promising batsman was losing confidence and form. The underlying problem was decompensated exophoria at distance and near, with a large slip in the non-dominant eye. Distance myopic correction was brought up to date to maximise accommodative convergence and orthoptic exercises given to improve and make the player aware of binocular control. Most importantly, the player was given an optometric explanation of why he was missing the ball
Archery – Female, age 35
Correcting the dominant myopic right eye with a soft contact lens prevented shooting consistently to the left of the target as the non-dominant left eye took over the aiming task
Football goalkeeper – Male, age 27
Incipient myopic astigmatism triggered accommodative spasm and a decompensated esophoria. Catching of high, crossed balls was misjudged with mistiming of tackles when diving at players' feet. Correcting a small amount of myopia with spherical contact lenses stabilised accommodation and revealed a convergence insufficiency. With vision corrected, convergence exercises restored the player's confidence and ability

What measures of vision are important in sport?

The purpose of a traditional eye examination, in addition to identifying any ocular abnormalities, is to reach an established norm for vision of 6/6. Yet we know from everyday practice that most people have the ability to see better than 6/6 and, as we have seen, research suggests that some athletes may have higher acuities than the general population. The fact is that 6/6 is not an indicator of an efficient and accurate visual system. Vision is much more than how well patients can read a static, perfectly contrasted chart in a perfectly illuminated room.

'Sight' – the clarity of the image on the retina – is just one aspect of visual performance. Vision is a motor as well as a sensory process and involves oculomotor skills such as accommodation, vergence and fusion. To maximise the contribution the eyes make to vision, the extraocular muscles of each eye must work as efficiently and effectively as possible for the individual visual demands required. As with any muscle, these eye muscles can be strengthened and fine-tuned. Beyond the eye, vision also involves the processing of information through the interpretation of visual images and perceptual processes.

The performance vision evaluation comprises a traditional eye examination to which additional specialist assessment techniques are added. It will include an eye health check and conventional measures of visual acuity and binocular vision, leading to a prescribing decision and appropriate vision correction where necessary. But depending on the individual sport and the level of participation, it may also include tests for other measures, such as dynamic visual acuity, dynamic fixation,[15] eye dominance, eye tracking, eye-hand-body coordination, peripheral awareness, visual reaction time, depth perception, high and low contrast LogMAR vision, and colour preference and light sensitivity.[16]

To determine which of these measures are important in any given sport, 'visual task analysis' is first needed to identify the visual skills that are most critical to the task. This should take into account factors such as the location and speed of both the object of regard and the observer, as well as considering environmental factors such as lighting, contrast and glare. Visual task analysis is an integral part of history taking in the performance vision evaluation.

Vision performance specialists also use the terms 'input' and 'output' in relation to understanding the role of vision in sport. Input comes from sight and visual skills, which, via visual processing, lead to a visually guided motor response or output. The principle underlying performance vision is that a well-trained and conditioned visual system leads a well-tuned motor system to perform at its peak. The aim is to create an environment allowing the individual to experience more, see more, observe more, learn more and become more visually efficient, using fewer inputs with less resistance for more elaborate outputs.

TABLE 3

Some suppliers of equipment used in sports vision practice

Supplier	Website	Contact details
Birmingham Optical Group	www.bog.co.uk	0845 230 3020
Evans Instruments	www.evansinstruments.co.uk	01842 766 004
Haag Streit	www.haag-streit-uk.com	01279 414 969
IOO Sales	www.ioosales.co.uk	020 7378 0330
Keeler	www.keeler.co.uk	01236 721 214
Lafayette Instrument Co Europe (Bassin Anticipation Timer)	www.lafayetteinstrument.com	01509 817 700
Micromedical Technologies (DVA)	www.micromedical.com	00 1 217 483 2122
Optimed	www.optimed.ltd.uk	02476 444 118
Paul Adler Optometrist	www.eyezone.co.uk	01462 732 393
Sportvision Ltd	www.sportvision.co.uk	0116 236 3113
Sports Vision Pty	www.sportsvision.com.au	00 612 9747 2518
Sussex Vision	www.sussexvision.co.uk	01903 851 951
Thomson Software Solutions	www.thomson-software-solutions.com	01707 654 689
Wayne Engineering (Saccadic Fixator)	www.wayneengineering.com	00 1 847 674 7166

What techniques will I use?

The test battery needs to include the fundamental elements that cut across most sports, ie visual acuity, binocular vision (or 'ocular alignment') and stereopsis (or 'eye teaming'). Practitioners will already have much of the equipment needed to carry out these tests. As in any eye examination, a thorough assessment of ocular health and an accurate refraction are essential.

The remainder of the test battery will be determined by the demands of the sport[17] and may include assessment of accommodation, versions and vergence, eye dominance, dynamic visual acuity, oculomotor function, reaction times and peripheral vision. Again, you may already carry out some of these tests in the course of your normal routine but other techniques, as we will see, may require additional equipment developed specifically for sports vision assessment, particularly if you intend to work with elite athletes and move into vision training. Examples here would be simple devices used in other areas of optometric practice such as the Brock String and more specialised equipment such as the Bassin Anticipation Timer, described in a later article.

Since some testing equipment for eye-hand-body coordination and training devices take up a sizeable space, you may need to find room in your practice to accommodate it. However, the introduction of new computer-based training techniques means that sports vision equipment is becoming more accessible, both to the practitioner and to the athlete. Be aware that your techniques may need to be adapted if you intend to carry out screening, evaluation or training outside your practice.

There is a very wide range of instruments available for sports vision testing and training but equipment does not need to be sophisticated or expensive in order to reveal significant information on how an athlete's eyes may be affecting his or her performance. In some cases, athletes may need referring to clinics where more equipment is available.

How can I find out more?

This series is not intended to be a comprehensive guide to sports vision practice but to stimulate interest in exploring the subject in more depth. Before getting involved in detailed sports vision assess- ▶

ment and training, you might want to further your knowledge in this area and learn more about the specialist equipment that is available.

Books and journals are one source of information but courses, conferences and meetings offer the opportunity for interaction with other interested professionals. You might also want to make contact with specialists in the UK through the Sports Vision Association[18] or The Sportvision Group (TSVG).[19] SVA membership provides a range of benefits, including publications, a journal, newsletter and events. The TSVG has also instigated the Diploma in Sport Vision Practice, which is a requirement of membership. In the US, where this specialty has been established longer, there are more reference sources. The American Optometric Association[20] Sports Vision Section has useful information on the visual requirements of individual sports. A useful resource, which includes practical advice on setting up a sports vision service, is the Pacific University College of Optometry Continuing Education Sports Vision.[21]

There are also various websites on performance, vision and sport, such as Peak Performance,[22] and instrument manufacturers are also a source of information on testing equipment. Table 3 lists some suppliers of equipment used in sports vision practice.

● In Part 2, Geraint Griffiths looks at the battery of tests that might be included when assessing athlete's vision and how to undertake a vision task analysis for the athlete's given sport.

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19 The Sportvision Group www.sportvision.co.uk.
20 American Optometric Association, www.aoa.org.uk.
21 Pacific University College of Optometry, Continuing Education Sports Vision, http://opt.pacificu.edu/ce/catalog/15876-GO/SportsVision.html.
22 Peak Performance, www.ppponline.co.uk.

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1 What is the most popular indoor sport in the UK?
A Badminton
B Snooker
C Darts
D Swimming

2 According to Beckerman *et al*, what proportion of athletes competing at a high level have never had a complete eye examination?
A None
B 25 per cent
C 50 per cent
D 75 per cent

3 According to Barr *et al*, what proportion of traumatic eye injuries attending hospital result from sporting activity?
A None
B 12.5 per cent
C 25 per cent
D 37.5 per cent

4 What is the single most commonly reported sport causing traumatic injury?
A Football
B Squash
C Badminton
D Tennis

5 Which of the following statements about ocular dominance has been verified by studies?
A Eye dominance is an infallible predictor of hand dominance
B The majority of yachtsmen are right-eye dominant
C In archery, up to 80 per cent of participants showed matched dominance
D Cricketers tend to show ipsilateral dominance

6 What proportion of all eye-related accident and emergency admissions are related to sport?
A 2 per cent
B 25 per cent
C 35 per cent
D 45 per cent

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